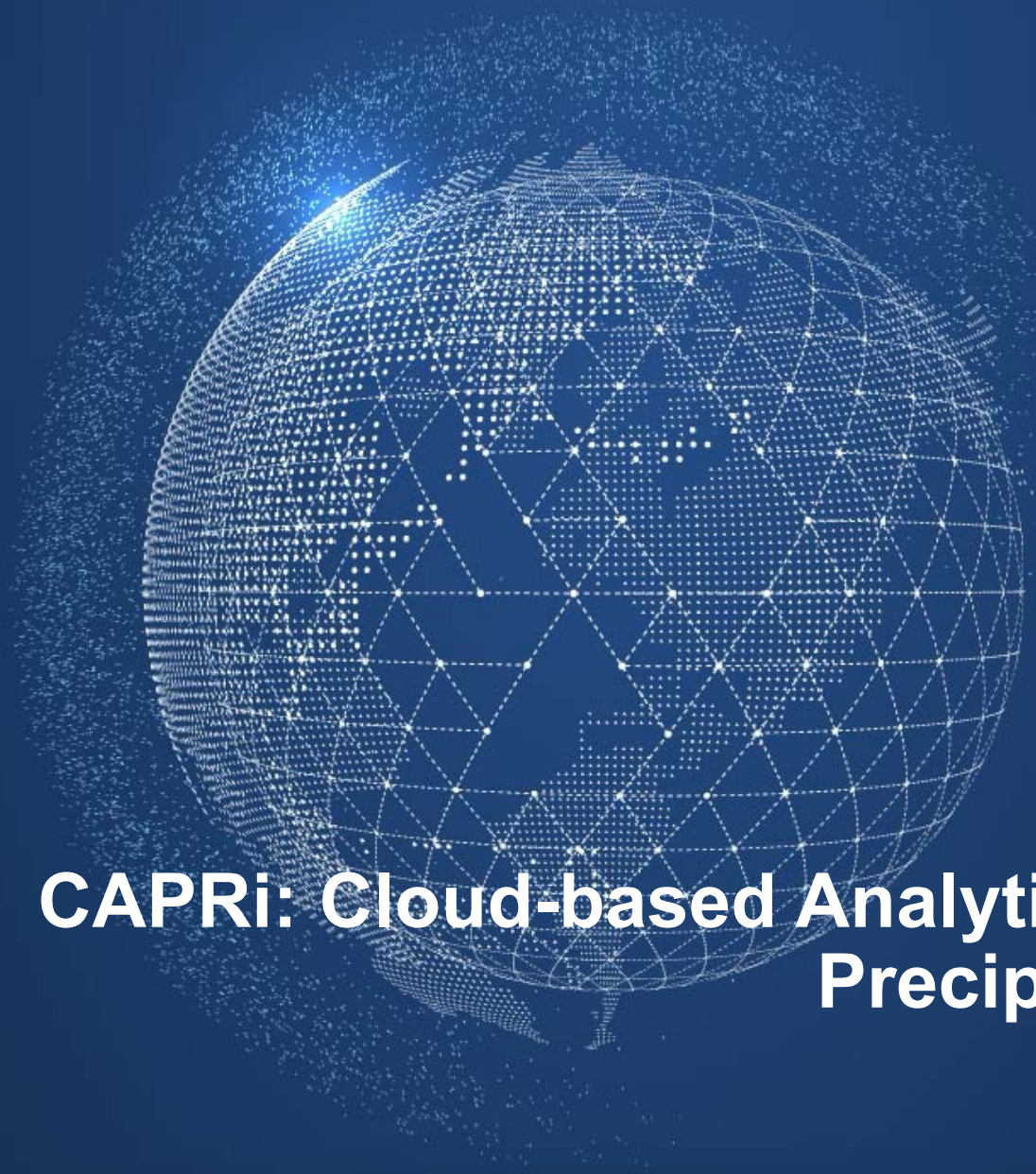


ESTF2021
Virtual Series

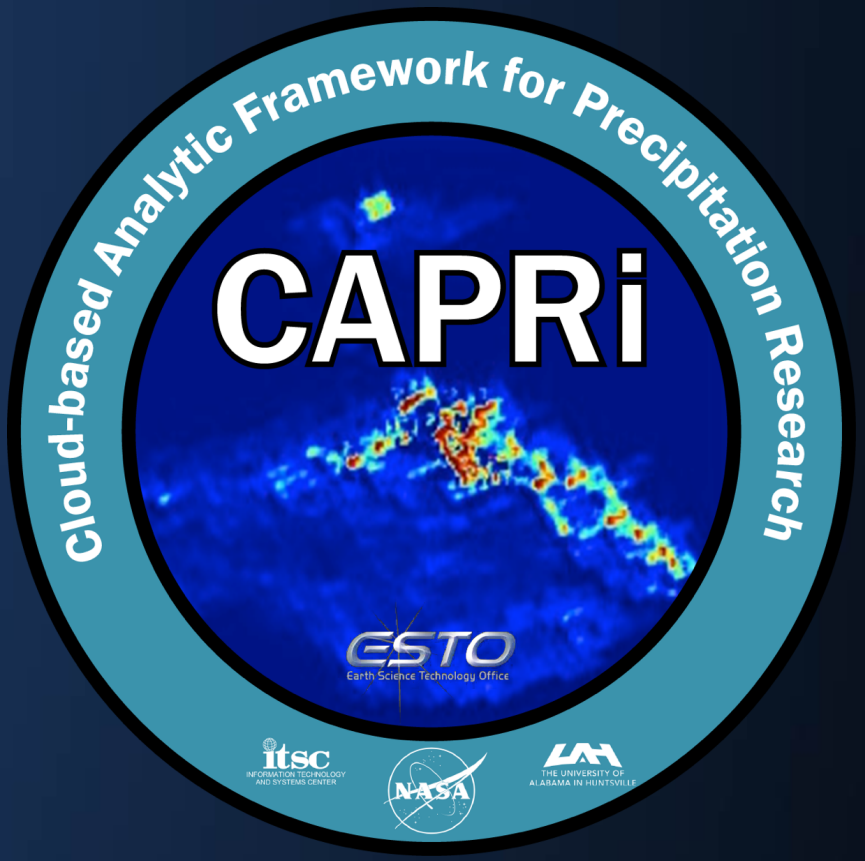
CAPRi: Cloud-based Analytic Framework for Precipitation Research

June 3, 2021 | 2:20 ET

Presenter:
Dr. John Beck UAH

Objectives

1. Develop a Cloud-based Analytical Framework for Precipitation Research (CAPRi) providing users with tools for on-demand data querying, fusion, sub-setting, extraction, visualization, and analysis of Global Precipitation Measurement (GPM) precipitation data.
2. Integrate Deep Learning models into CAPRi for super-resolution of GPM Dual Precipitation Radar (DPR) data using the GPM Ground/Airborne Validation Network (VN).
3. Use CAPRi services and the results from the super-resolution Deep Learning exercise to identify 3D precipitation features.

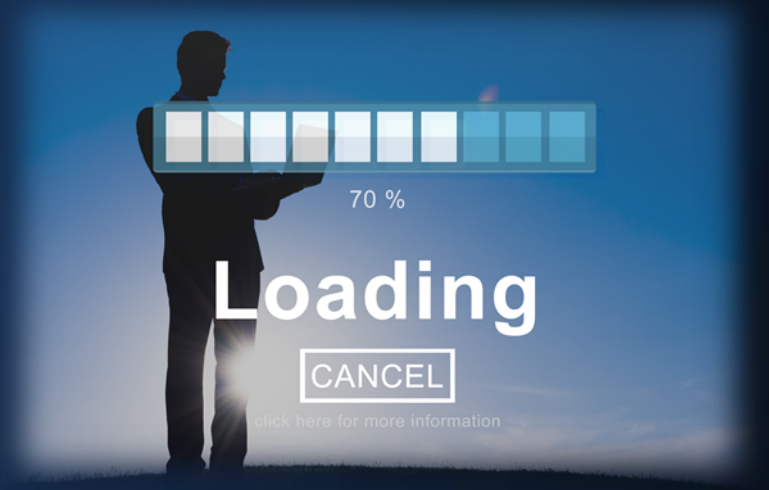


Science Relevancy

- Preparing, assembling, and using Earth science datasets often requires a great deal of time and effort.
- Many scientific data sets and analysis tools are now located on cloud-based platforms that can have steep learning curves.
- The complexity of such datasets limits their use in research and applications, especially advanced data analytics and data fusion techniques such as deep learning.
- An easy to use automated cloud-based framework equipped with APIs and deep learning models would increase the use of space-based precipitation data.

Impact

- To compare GPM and Ground Radar variables in the VN it requires processing thousands of NetCDF files
- Reading and processing the VN files is slow and must run in batches for multiple fixed variable combinations and time periods
- CAPRi provides services to extract VN data from NetCDF files and store them on the AWS cloud in the Athena interactive query service
- Athena supports traditional SQL-like queries and can dramatically improve query speed



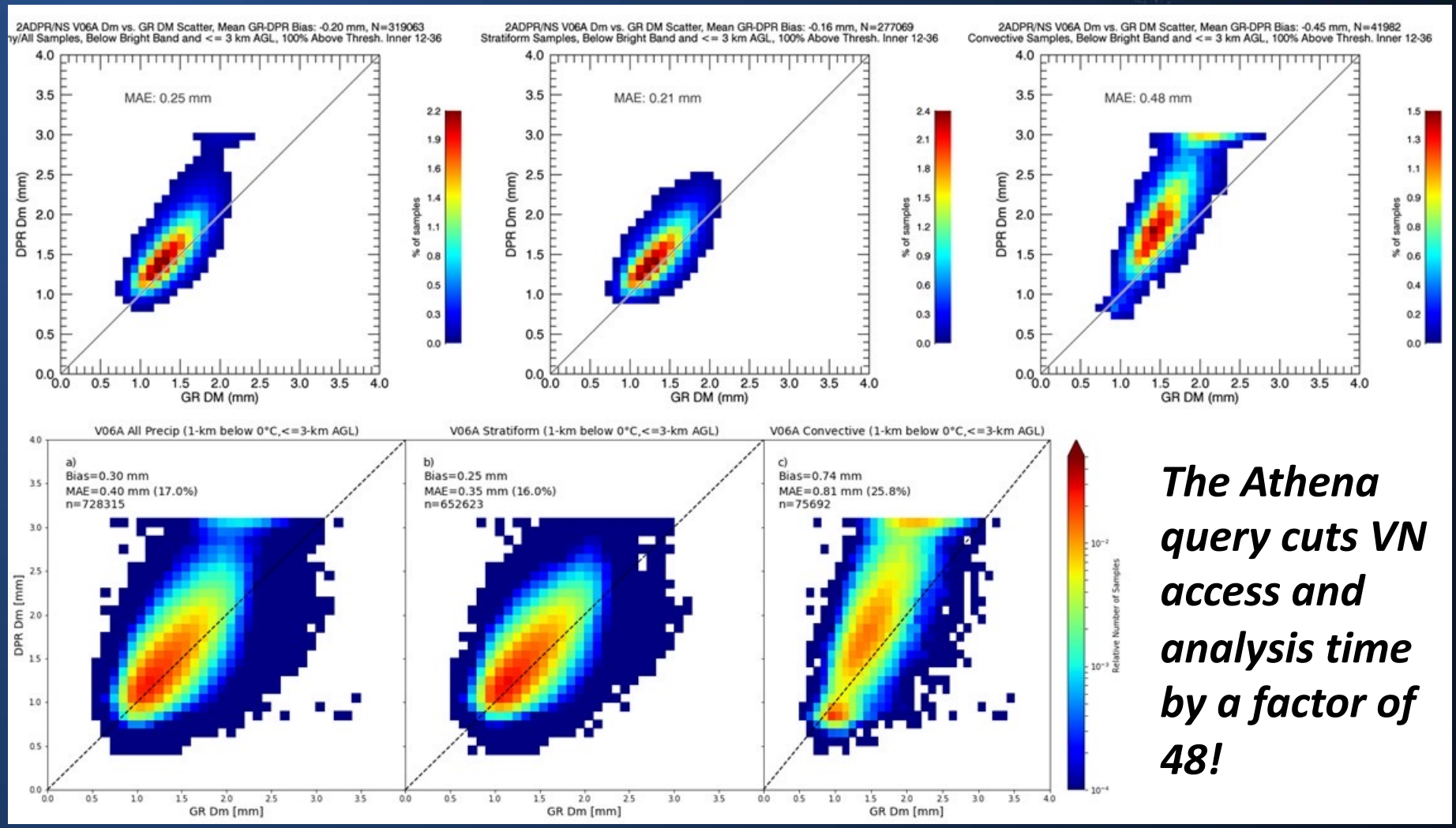
- Enhanced performance of using Athena queries vs. reading NetCDF files allows for interactive analysis using Python and Javascript code (2D histogram plots)
- Therefore, VN data access is dramatically improved by use of AWS cloud

Impact

Athena Query Example

Traditional
File-based access
IDL
~320k matchups
(35min)

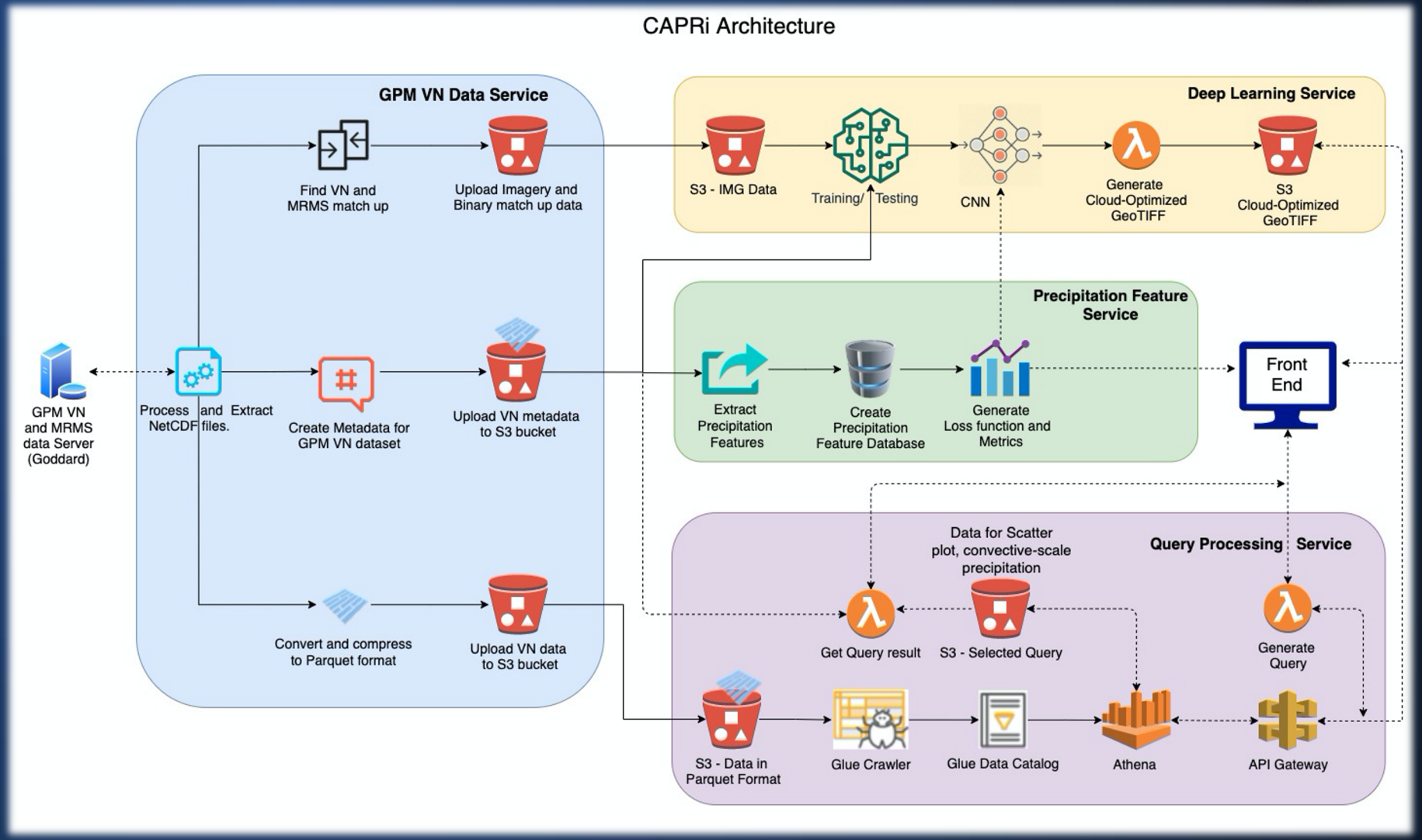
CAPRi
Athena
Python
~728k matchups
(*<43s*)



The Athena query cuts VN access and analysis time by a factor of 48!

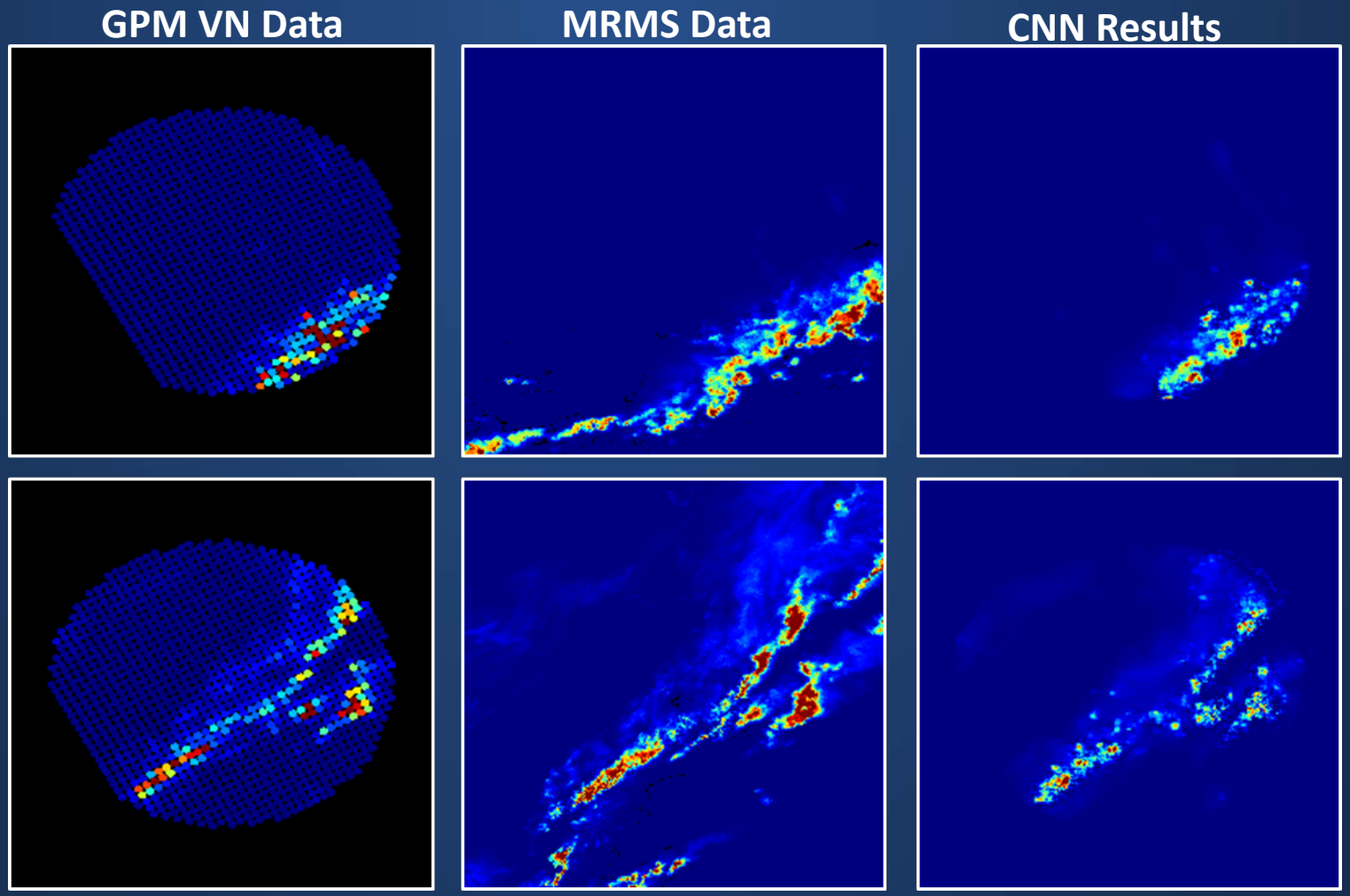
Technical Details

CAPRi Architecture



Technical Details

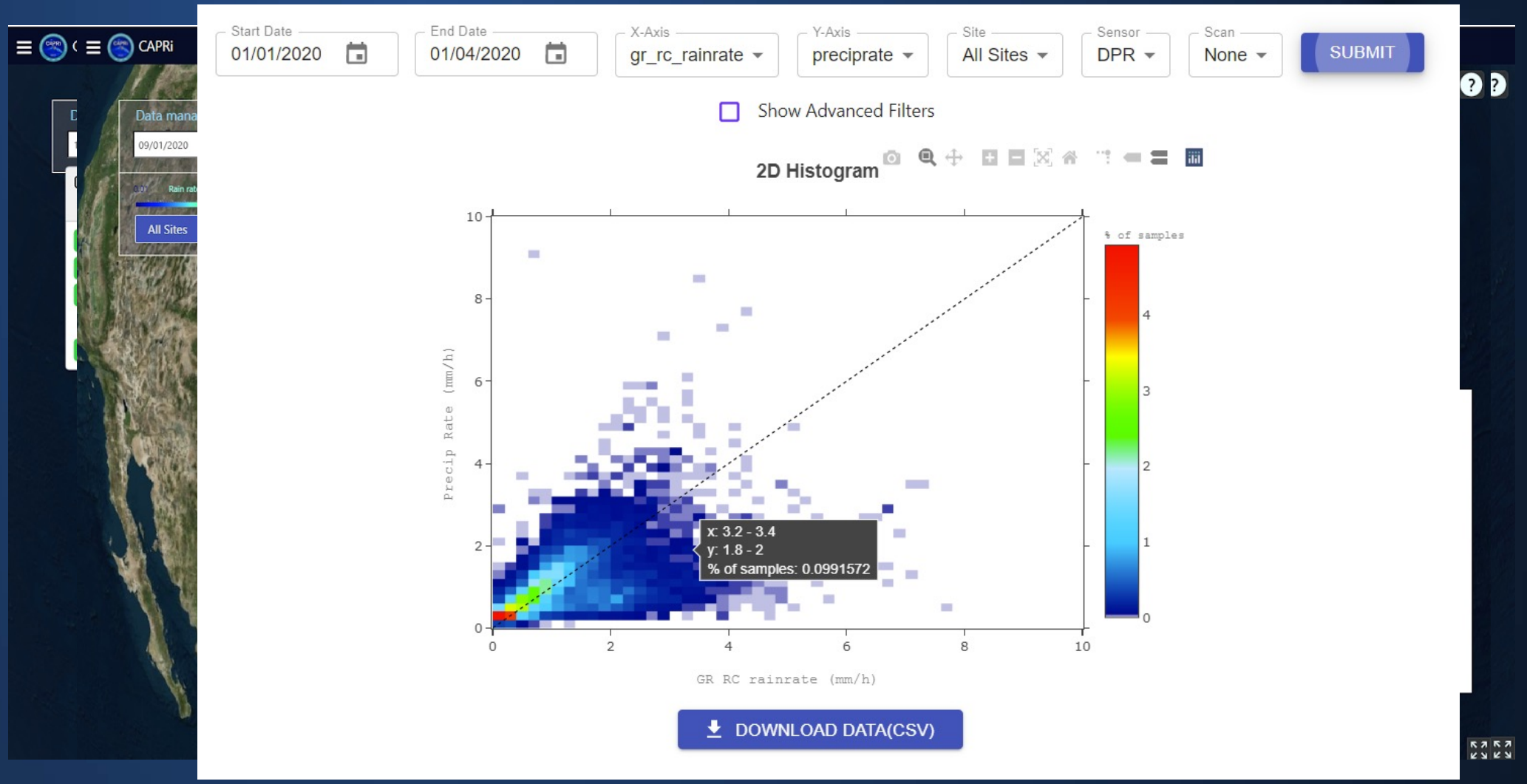
Deep Learning - Results



- Conducted a series of experiments to determine the best course of action for the design of Convolutional Neural Network for conducting Super Resolution.
- Developed scripts to create both binary data and imagery of surface rain rate from GPM VN and MRMS for the Deep Learning training.
- Finalized the design of the CNN, trained the CNN with data, and produced results.
- Working with Co-I Gatlin to ensure results of the Super Resolution are not over-fitting the data prediction.

Technical Details

CAPRi Front End Interface



Technical Details

- To demonstrate this technology, we propose to use CAPRi services for identifying convective scale 3D precipitation features.
- Convective scale allows us to better separate out trends in how precipitation is being delivered. The 3D component will allow us to investigate the drivers, link to lightning, and support future modeling efforts.
- Our integrated Deep Learning architecture conducts super-resolution on GPM precipitation data using Multiple Radar Multiple Sensor (MRMS) data as a high-resolution ground truth.
- Results will be used in for identifying 3D precipitation features